

This study quantifies and contrasts the vaccination effort required to arrest the propagation of an online meme whose b...  
 Introduction Viral information—memes, rumours, or misinformation—can disseminate rapidly across online social platforms.  
 Methodology Network Construction Because only aggregate degree statistics are provided, a configuration model [0] was

A  $10^4$ -node degree sequence sampled from this bi-modal distribution was realised (Python script `network_construction.py`).  
 Epidemic Model A standard SIR process was implemented using the FastGEMF simulator. Edge-based infection at rate  $\beta$ .  
 Vaccination Scenarios Random immunisation A fraction  $f$  of nodes is selected uniformly at random and moved to the infected state.  
 Simulation Protocol For each scenario five stochastic realisations were executed up to  $t = 300$ . Script `simulation_11_12.py`.  
 Analytical Results Random Vaccination Threshold Under heterogeneous mean-field theory [0], the epidemic threshold  $\theta_c$  is

Vaccinating three quarters of the population at random is therefore sufficient.

**Degree-Targeted Threshold** Let  $f$  denote the fraction of degree-10 nodes vaccinated. After removal, the residual moment  $\langle k^2 \rangle_{res} = \frac{100p_{10}(1-f)+4(1-p_{10})}{1-p_{10}f}$ , which yields

Setting  $q_{res} = 1$  and solving gives  $f_c = 1$ . Consequently

Notably, although this is the entire high-degree subset, the global coverage is markedly lower than random vaccination.

**Simulation Results** Key epidemic metrics averaged over the five stochastic runs are summarised in Table . Vaccinated individuals

	Strategy	Peak prevalence (%)	Peak time	Final attack (%)
[!t] Simulation outcomes. Population size $N = 10\,000$ .	Random (75%)	0.14	1.11	0.28
	Degree 10 (12.5%)	0.13	4.47	1.42

Figures and depict the temporal compartment trajectories for a representative realisation.

[http] [width=0.85]results-11.png Population dynamics under 75 % random vaccination. Infection fails to sustain and dies out.

[http] [width=0.85]results-12.png Population dynamics when all degree-10 nodes are vaccinated. A minor outbreak occurs.

**Discussion** Analytical thresholds aligned closely with stochastic simulation. Random vaccination at  $p_c = 75\%$  essentially

These findings corroborate earlier theoretical work showing the superiority of degree-based strategies when node degree distributions are unimodal.

**Limitations** include the simplified two-point degree distribution, absence of clustering, and perfect vaccine assumption.

**Conclusion** The study demonstrates that for a meme with  $\mathcal{R}_0 = 4$  on an uncorrelated network of mean degree 3, immunising

\*Acknowledgement The computational experiments utilised the FastGEMF library.

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Code Availability All Python scripts and data files generated during this work are located in the `output` directory:

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network_construction.py
network.npz
simulation_11_12.py
results-11.csv, results-11.png
results-12.csv, results-12.png
analysis_metrics.py
```